

Oscillating Systems

Name: _____ Section: 2AL-____ Date performed: ____/____/____

Lab station: _____ Partners: _____

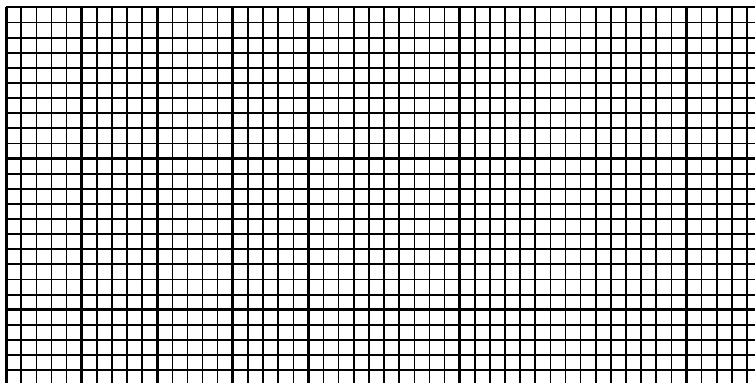
A. Translational System

(Q-1) Find the theoretically predicted period of the spring-mass system.

Derive an expression for T_{th} in terms of the spring constant (k), the hanging mass (M_{h}), and the mass of the spring (M_{s}).

Find the spring constant.

hanging mass (g)	50	150	250	350	450
hanging weight (N)					
position (m)					



$$k = \underline{\hspace{2cm}} \pm \underline{\hspace{2cm}}$$

Record the assigned value of the hanging mass and measure the spring mass with the electronic balance.

$$M_h = \underline{\hspace{2cm}} \quad M_s = \underline{\hspace{2cm}}$$

Calculate the theoretical period, along with its uncertainty ($\delta T_{\text{th}}/T_{\text{th}} = (1/2)\delta k/k$).

$$T_{\text{th}} = \underline{\hspace{2cm}} \pm \underline{\hspace{2cm}}$$

(Q-2) Now measure the period of the spring-mass system experimentally (measure the period 5 times and use Rule 8 from “Measurement and Calculation”).

Total time (s)					
Number of cycles					
Period (s)					

$$T_{\text{ex}} = \underline{\hspace{2cm}} \pm \underline{\hspace{2cm}}$$

(Q-3) Compare the two values using the discrepancy test.

Do they agree? Explain.

B. Rotational System

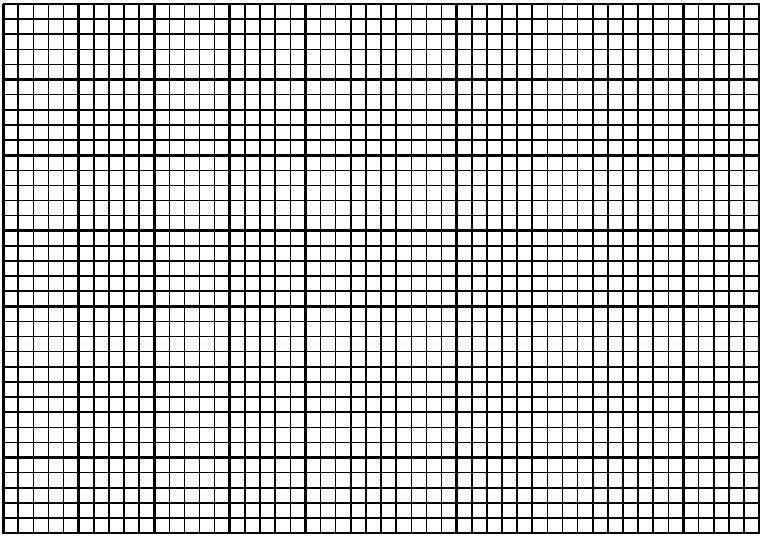
(Q-4) Find the theoretically predicted period of the torsional pendulum.

Derive an expression for T_{th} in terms of the torsional spring constant (κ) and the rotational inertia of the disk (I).

Find the torsional spring constant.

Torsion lathe diameter = _____ radius = _____

hanging mass (g)	50	150	250	350	450
torque (N m)					
angular position (deg)					
angular position (rad)					



$\kappa =$ _____ \pm _____

Record the mass of the disk, determine its radius, and use these values to calculate its rotational inertia.

$$M_{\text{disk}} = \underline{\hspace{2cm}} \quad \text{diameter} = \underline{\hspace{2cm}} \quad \text{radius} = \underline{\hspace{2cm}}$$

$$I = \underline{\hspace{2cm}}$$

Calculate the theoretical period, along with its uncertainty.

$$T_{\text{th}} = \underline{\hspace{2cm}} \pm \underline{\hspace{2cm}}$$

(Q-5) Now measure the period of the torsional pendulum experimentally.

Total time (s)					
Number of cycles					
Period (s)					

$$T_{\text{ex}} = \underline{\hspace{2cm}} \pm \underline{\hspace{2cm}}$$

(Q-6) Compare the two values using the discrepancy test.

Do they agree? Explain.

C. Fluid System

(Q-7) Find the theoretically predicted period of the fluid system (U-tube).

Derive an expression for T_{th} in terms of the effective length of the fluid ($L = V/A$) and the gravitational constant (g).

Find the effective length of the fluid.

$$V = (\text{_____} \pm \text{_____}) \text{ cm}^3 \quad \text{Inner diameter} = (\text{_____} \pm \text{_____}) \text{ cm}$$

$$L = V/\pi(d/2)^2 = (\text{_____} \pm \text{_____}) \text{ cm}$$

Calculate the theoretical period, along with its uncertainty ($\delta T_{\text{th}}/T_{\text{th}} = (1/2)\delta L/L$).

$$T_{\text{th}} = \text{_____} \pm \text{_____}$$

(Q-8) Now measure the period of the fluid system experimentally.

Total time (s)					
Number of cycles					
Period (s)					

$$T_{\text{ex}} = \underline{\hspace{2cm}} \pm \underline{\hspace{2cm}}$$

(Q-9) Compare the two values using the discrepancy test.

Do they agree? Explain.

Exercises

Suppose more hanging mass is added to the spring-mass system. What would happen to the period of oscillations?

- (A) The period will increase.
- (B) The period will decrease.
- (C) The period is unaffected.
- (D) The answer depends on the specific values of the spring constant and the mass.

Suppose the spring in the spring-mass system is replaced by another spring with the same mass but a greater spring constant. What would happen to the period of oscillations?

- (A) The period will increase.
- (B) The period will decrease.
- (C) The period is unaffected.
- (D) The answer depends on the specific values of the spring constant and the mass.

Suppose that the spring-mass system is not changed, but the amplitude of oscillations is increased. What would happen to the period of oscillations?

- (A) The period will increase.
- (B) The period will decrease.
- (C) The period is unaffected.
- (D) The answer depends on the specific values of the spring constant and the mass.

Suppose more water were added to the fluid system. What would happen to the period of oscillations.

- (A) The period will increase.
- (B) The period will decrease.
- (C) The period is unaffected.
- (D) The answer depends on the specific values of L and g .

When you measured the period of oscillations for the fluid system, you should have noticed that the oscillations died out rather quickly (i.e., the amplitude of oscillations rapidly decreased). What happens to the mechanical energy of an oscillating system as the amplitude decreases?

What is your best guess as to the reason why the oscillations died out in the fluid system?

Would you expect something similar to happen with the other oscillating systems? For example, suppose you set the spring-mass system in motion and waited a few minutes. Do you think the amplitude will still be as large as it was when you first set the system in motion? Explain your answer.